DOCUMENT RESUME

ED 204 111 SE 035 156

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TITLE The Effects of Three Kinds of Feedback on Math Teaching Performance.
PUB DATE Apr 81
NOTE 19p.; Paper presented at the Annual Meeting of the American Educational Research Association (Los Angeles, CA, April 13-17, 1981).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Educational Research; Elementary Education; *Elementary School Mathematics; *Elementary School Teachers; Feedback; Higher Education; *Inservice Teacher Education; Learning Theories; *Mathematics Instruction; Models; Teacher Education; *Teaching Methods
IDENTIFIERS Direct Instruction Model; *Mathematics Education Research; *Missouri Mathematics Effectiveness Project

ABSTRACT

The primary purpose of this investigation was to determine if a teacher's level of implementation of the direct instruction model would vary as a function of the type of feedback received during initial attempts to apply the model. Twenty-five elementary school teachers were randomly assigned to one of three treatment conditions: (1) nine worked alone while analyzing tape recordings of two practice lessons; (2) nine received some feedback from the instructor during these analyses; and (3) seven worked through the practice tapes with their colleagues. The results of an ANCOVA test suggested that members of the three treatment groups did not differ in their overall level of implementation of the model during the lesson that served as the post test. Different types of feedback did not result in different levels of implementation of the model. However, there was some evidence that the three treatments did influence teachers to focus on different classroom events during their analyses of the practice lessons. (Author/MP)

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THE EFFECTS OF THREE KINDS OF FEEDBACK ON MATH TEACHING PERFORMANCE

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Paper presented at the American Educational Research Association Annual Conference, Los Angeles, California, April, 1981

SE 035 156

Abstract

This study was developed as an extension of the process-product approach to research on teaching. It focused on the effectiveness of three interventions in facilitating the implementation of the direct teaching model for mathematics instruction. Three experimental groups of teachers were pre and post tested to provide measures of the dependent variables in the study. Preliminary results supporting those of Good and Grouws (1979) in the Missouri Mathematics Effectiveness Project indicated that teachers generally implemented the instructional model and that certain components were more readily adopted than others. The findings raise important questions regarding interventions designed to improve teaching performance.

THE EFFECTS OF THREE KINDS OF FEEDBACK ON MATH TEACHING PERFORMANCE

Introduction

Traditionally, teacher education practices have relied on formal courses and supervised field experiences to prepare preservice and inservice teachers. The assumption has been that, as a result of these experiences, teachers will be adequately prepared to apply critical teaching skills. More recently, this basic assumption has been challenged along several fronts (Howey, Yarger, and Joyce, 1978). Various phenomena such as increased emphasis on the professional development of inservice teachers and increasingly stringent evaluation requirements of externally funded programs have resulted in a more critical examination of the quality of teacher education interventions.

As a first step toward improving teaching practice, the process-product approach to research on teaching has attempted to identify critical teaching skills, i.e., those that enhance student learning (e.g., Brophy and Evertson, 1976; Good and Grouws, 1978; McDonald, 1976; Stallings, 1976). The direct instruction model for teaching elementary school mathematics, advanced by the Missouri Mathematics Effectiveness Project, is a direct outgrowth of these research efforts (Good and Grouws, 1979). This model provides specific descriptions of the critical components of mathematics instruction that have been identified through process-product research (e.g., 8 minutes of daily review; 15 minutes of uninterrupted practice). Recently, the Missouri project has shown that teachers can be readily persuaded to use the model in their classrooms (Good and Grouws, 1979). This investigation extends the same line of inquiry one step further to include an analysis of the effects of feedback during the teachers' initial attempts to implement the direct instruction model.

Virtually all teacher educators believe that feedback on teaching has a positive influence on teaching performance. Despite this general recognition, inservice teacher preparation programs have traditionally relied on formal coursework as the dominant instructional mode. Recently, some of these programs have begun to incorporate classroom observations and feedback into the instructional programs (e.g., Duke, 1977; Jacobs, 1973; Lawrence and Brach, 1978; Roper, Deal, and Dornbusch, 1976). The type of feedback has varied from program to program, but has tended to rely on a person serving in a non-evaluative role, such as the teacher analyzing recordings of his/her own performance or feedback from a field-based college instructor or a colleague.

Research on the effectiveness of feedback in teacher education has generally suffered from two basic deficiencies. First, feedback has typically been contrasted with a no feedback control condition; there has been little attempt to examine the relative influences of different forms of feedback. Second, most studies of this type have measured effectiveness through self-report surveys or interview responses from teachers (e.g., Duke, 1977; Roper et al., 1976). The design of this investigation overcomes both of these shortcomings. Three different types of feedback are compared, and the dependent variables represent measures of changes in classroom teaching performance rather than self-report data.

Purpose

The purpose of this investigation was to determine if feedback during initial practice lessons would enhance a teacher's level of implementation of the direct instruction model. Specifically, the study was designed to provide answers to three questions:

(1) Will elementary school teachers implement the direct instruction model for teaching mathematics when encouraged to do so?

(2) Will the likelihood that a teacher will implement the model vary as a function of the kind of feedback she has received (self-analysis, feedback from an instructor, or feedback from a colleague)?

(3) Will the level of implementation vary across the specific components of the model?

Method

Sample

Twenty-seven female elementary school teachers from districts located in mid-Michigan participated in this investigation. Throughout the course of the study, these individuals were enrolled in one of two sections of an off-campus graduate class in which the principal investigator served as both instructor and researcher. One section of the class was taught in North-central Michigan and included 10 teachers; the other was offered in South-eastern Michigan to 17 teachers. Twelve of the 27 teachers taught at the lower elementary level (grades K-3); 14 worked in upper elementary school classrooms (grades 4-6); and one taught 7th grade mathematics.

The Direct Instruction Model

The direct instruction model was developed as a part of the Missouri Mathematics Effectiveness Project (Good & Grouws, 1978). The basic components of the model call for teachers to conduct forty-five minute math lessons each day in which they devote 8 minutes to daily review, 20 minutes to developing student understanding of math concepts and skills, and 15 minutes to uninterrupted successful practice. In addition to the timed dimensions of a lesson, teachers are encouraged to assign fifteen minutes of homework on Mondays through Thursdays and to conduct weekly and monthly reviews.

They are also expected to ask students to solve problems without pencil and paper, to alert students that their work will be corrected, and to correct seatwork assignments.

Treatments

During the third meeting of the graduate class, the instructor-researcher described the general outline of the experiment. During this discussion, she also described the origin and characteristic features of the direct instruction model. Near the end of the meeting she distributed copies of the Missouri project's forty-five page manual that provides detailed descriptions of the model. Two weeks later, teachers received additional instruction in using the model. During this class session, they were encouraged to ask questions and to discuss problems and concerns with regard to using this approach in their classroom.

Over the next four weeks, participants were asked to audiotape two mathematics lessons in which they attempted to practice the direct instruction model. The analysis of these tapes served as the primary instructional activity on which this experiment focused. Prior to this time, the teachers tape recorded two class sessions. The first taping was designed to acclimate the teacher to the recording process; the second served as the pretest for the experiment.

Variations in the manner in which teachers received feedback regarding the success of their practice lessons served as the treatment variable in this experimental investigation. A stratified random assignment procedure was used to assign teachers to one of three treatment groups. The two variables that were considered in stratification were location of the graduate class in which the teacher was enrolled and the type of school in which the teacher worked -- public or parochial. The three treatments were as follows:

Group I - (n = 9) - Self Analysis: The teachers in this group worked alone. A criterion checklist suggested by the specific components of the direct instruction model served as the focus of their analysis of the two practice lessons (e.g., How many minutes did you spend on review? Did you assign homework?)

Group II - (n = 10)- Instructor Feedback: This group completed the same procedures as Group I. However, they also received some feedback from the instructor during the lesson analysis activities.

Group III - (n = 8) - Colleague Interaction: Teachers in this group were joined by a colleague in the analysis of their teaching. Use of the criterion checklist and other analytical procedures were identical with those of the first group.

The entire treatment program occurred over a period of eight weeks. It culminated in an audiotaped math lesson during the ninth week that served as the post test. Efforts were made to isolate the teachers within the treatments from collaboration with the instructor or each other during the program, except as specified by the treatments. Unfortunately, there was an attrition of two individuals from the final sample. One member of Group II was excluded when it was discovered that her pretest tape recording was inaudible. A member of Group III was not included in the final analysis because she had been reassigned during the course of the study and no longer taught mathematics.

Implementation Scores

To assess the degree of implementation of the direct teaching model, two coders used a double blind procedure to record the presence, absence or duration of specific instructional events during the pre and post test lessons. Intercoder reliabilities for each code were assessed. Results revealed 95 percent or better interactor agreement on each of the variables employed to assess implementation. These variables were as follows:

Daily Review - The number of minutes the teacher devoted to review of the previous lesson or review of any type.

Development - the number of minutes the teacher devoted to improving student comprehension of skills and concepts.

Seatwork - the number of minutes the students practiced work individually at their desks.*

Mental Computation - Did the teacher ask students to work problems in their heads?

Alerting - Did the teacher tell students their work would be corrected?

Accountability - Did the teacher check students' seatwork toward the end of this phase of the lesson?

Homework - Did the teacher assign homework?

Various combinations of these variables provided three general measures of the extent to which teachers implemented the instructional model. The first, and most important measure, was an overall implementation score that was computed for each teacher using a formula adapted from the work of Ebmeier (1978):

$$\text{Overall Implementation} = \frac{2(\text{Daily Review Time})}{8} + \frac{2(\text{Development Time})}{20} + \text{Seatwork} + \text{Mental Composition} + \text{Alerting} + \text{Accountability} + \text{Homework}^{**}$$

By computing the total time the teacher spent in review and development activities, it was also possible to determine the number of minutes she was in front of the class teaching mathematics. Finally, by summing across the five dichotomous variables, it was possible to measure the teacher's willingness to apply the five specific behaviors the model encouraged her to use.

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*Because nearly 1/2 of the teachers in the sample inadvertently shut off their tape recorders at the time their students began to work on seatwork assignments, it was impossible to measure time spent on seatwork. This variable was, therefore, converted to a dichotomous scale; namely, was seatwork assigned?

**Each dichotomous variable was scored as one if it was present or a zero if it did not occur during the lesson.

The first of these two variables will be labeled total review and development time; the second will be referred to as the total components score.

Results and Discussion

The summary of results is presented in three sections corresponding to the research questions that served as the focus of this investigation: (1) Did the teachers implement the direct instruction model as a result of the treatment programs? (2) Did level of implementation of the model vary as a function of the type of feedback teachers received? (3) Were the teachers more willing to apply some components of the model than others?

Willingness to Apply the Model

As described earlier, three general measures were used to determine the extent to which teachers applied the direct instruction model before and after their participation in this experiment. Mean pre and post test scores for the three scales are summarized in Table 1. As expected, post test means were higher than pretest means across all three measures. The results of t-tests are also portrayed in Table 1 and in each case indicate that the difference was statistically significant when the likelihood of a Type I error was set at .01. In other words, teachers who participated in this experiment did incorporate the direct teaching model into their daily mathematics instruction.

Although the data summarized in Table 1 provide convincing evidence that teachers were generally willing to apply the model, they do not address the more demanding question of the extent to which individual teachers changed their classroom performance. In other words, did all of the participants attempt to apply the model? The response of individual teachers to the experimental conditions can be portrayed in a relatively straightforward fashion as in Table 2. For this comparison, overall implementation scores

Table 1

Means, Standard Deviations, and T-Values for General Measures of Implementation (N = 25)

Measure		Pre	Post	t-Value
Overall Implementation				
	Mean	2.78	5.33	6.47**
	SD	1.14	1.55	
Total Review & Development Time				
	Mean	14.48	20.24	4.01**
	SD	6.35	6.71	
Total Components				
	Mean	1.20	2.84	5.48**
	SD	.75	1.35	

**$p < .01$

which range from zero to nine were divided into three subcategories: low (0-3), average (4-6), and high (7-9). Although these subdivisions are arbitrary, it is possible to generate a general description of the performance of teachers at each level. Low scores are most apt to reflect considerably less time spent on math than that called for in the model, as well as a general failure to apply most of the specific components described by the model (e.g., mental computation). In order to attain an average score, a teacher would spend at least fifteen minutes on daily review and development, compared to a recommended twenty-eight minutes in the model, and would follow the instruction with some specific components, like seatwork, but not others. High implementors would spend even more time on mathematics and would demonstrate most of the specific teaching behaviors called for in the model.

Table 2

Comparison of Number of Teachers at Each of Three Levels of Implementation on Pre and Post Tests

		Post	
Pre	Low (0-3)	Average (4-6)	High (7-9)
Low (0-3)	4	11	5
Average (4-6)		2	3

As the figures in Table 2 suggest, 20 of the 25 teachers scored at the low implementation level on the pretest; 5 had average scores. In other words, in the sample lesson obtained prior to the experiment, only 5 of the 25 teachers provided math instruction in a manner that approximated the direct instruction model. As a result of their participation in the experiment, all but six of the teachers moved in the direction of higher levels of application of the model. Only four teachers scored at the low level on both the pre and post test. Thirteen of the 25 teachers scored at the average level on the post test, and 8 scored at the high level of implementation on this measure. In other words, most teachers were persuaded to use the model after a relatively brief period of training in its use.

Although it is clear from the figures in Table 2 that most teachers were receptive to using the direct instruction model, it is also evident that some teachers resisted its application. Furthermore, only eight of the twenty-five teachers were enthusiastic enough to score at the high level of application on the post test. These data raise a critical question of whether or not there were characteristic differences between those teachers who attempted to apply the model and those who did not. Unfortunately, the data analyses suggested by this question are at a preliminary, rather than a final, stage of development. However, it appears that teacher attitudes or beliefs will emerge as the most critical factor underlying teacher resistance. Although some teachers appear to have resisted the model in its entirety, most who did not move in the direction of greater use were resistant to one or more of its specific components. Their lack of enthusiasm for these specific components could typically be traced to firmly held beliefs that ran counter to practices suggested by the model (e.g., early elementary teachers who felt that 45 minute mathematics lessons were too long for their youngsters).

Overall Implementation by Treatments

The primary question of interest in this study was whether or not a teacher's level of application of the direct instruction model would vary as a function of the kind of feedback received during initial attempts to practice the model (self-analysis, feedback from the instructor or feedback from one's colleagues). Table 3 summarizes the results of an Analysis of Covariance Test that was suggested by this question. Overall implementation scores on the post test served as the dependent variable in this analysis; pretest scores served as the covariate. As these data suggest, adjusted means on the post test were very nearly equal for all three treatment groups. It is, therefore, not surprising that the F-ratio resulting from the ANCOVA test was extremely small. In brief, the overall level of implementation of the direct instruction model did not appear to vary as a function of the type of feedback the teacher received.

Table 3

Group Comparisons of Implementation Scores: Adjusted Means and Results of ANCOVA Test

Treatment	n	Adjusted Post Test Means	Analysis of Covariance Source	df	MS	F
Self-Analysis	9	5.26				
Instructor-Feedback	9	5.25				
Colleague-Interaction	7	5.53	Covariates	1	20.53	5.12*
			Main Effects	2	.19	.05
			Residual	21	4.01	
			Total	24	4.38	

*$p < .05$

Implementation of Specific Components of the Model

The final question considered in this investigation was whether teachers were more willing to apply some of the specific components of the model than

others. Specific components include the two timed variables (review and development time) and the five dichotomous variables (seatwork, mental computation, alerting, accountability, and homework). Pre- and post test means for each of these variables are summarized in Table 4. This table also considers the two combination measures (total review and development time and total number of dichotomous components applied), as well as the results of t-test comparisons of pre- and post test means.

The final three rows of Table 4 summarize changes in each of the variables for all participants in the study. As these figures suggest, post test means were uniformly higher than pretest means across all measures. However, the level of change in performance was clearly greater for some specific components than for others. The significant increase in total instructional time devoted to review and development activities that was reported earlier, for example, may be traced almost entirely to additional time spent on review. Time spent on development was relatively high on the pretest and did not increase significantly on the post test.

Teachers were more likely to make seatwork assignments on both the pretest and post test than they were to apply any of the other specific components. The greatest increases in level of application occurred for alerting and accountability; the smallest increases were for mental computation and homework. In fact, homework was the specific component that was least likely to be applied on both the pretest and the post test.

It is not surprising that so few teachers assigned homework. Many of the teachers surveyed in this program were opposed to assigning homework at the elementary level, especially for students in grades Kindergarten through third. Teachers also mentioned the extra workload associated with grading homework and preparing worksheets. Some even cited parent attitudes regarding homework as critical to their decisions in this area.

Table 4

Group Comparisons of Specific Measures of Implementation - Means, Percents and T-Values

		Time in Minutes			Percent of Teachers Who Applied					
		Review	Devel.	Total R.&D.	Seat Work	Ment. Comp.	Alert.	Acct.	Home Work	Total Comp.
By Treatment Groups										
Self-Analysis (n = 9)										
	Pre	1.22	11.89	13.11	44	33	11	11	0	1.11
	Post	8.78	14.11	22.89	89	44	63	25	25	2.33
	t-value	2.36*	0.95	4.43**						2.03*
Instructor Feed. (n = 9)										
	Pre	2.67	13.22	15.89	78	44	11	11	0	1.44
	Post	5.11	13.89	19.00	78	67	67	67	33	3.11
	t-value	1.34	0.27	2.00*						3.54**
Colleague-Inter. (n = 7)										
	Pre	4.14	10.29	14.43	86	14	0	0	0	1.00
	Post	8.14	10.14	18.29	86	29	86	86	29	3.14
	t-value	.90	-0.05	1.14						5.30**
Three Groups Combined	(N = 25)									
	Pre	2.56	11.92	14.48	68	32	8	8	0	1.20
	Post	7.28	12.92	20.24	84	48	68	56	28	2.84
	t-value	2.63*	0.69	4.01**						5.48**

*p < .05 **p < .01

The data in Table 4 also describe specific changes in performance for each of three treatment groups. Earlier analyses indicated that the three groups did not vary in overall level of implementation. However, the data in Table 4 provide some reason to believe that the type of feedback a teacher received may have differentially affected her receptivity to specific components of the model. The increase in instructional time devoted to review and development, for example, was considerably higher for members of the self-analysis group than for those who reviewed tapes of practice lessons with their colleagues. These two groups also differed the most in regard to increases in applying specific components of the model. However, it was the colleague-interaction group that was most apt to adopt specific practices such as alerting and accountability that were called for by the model. Although it is difficult to account for the source of these differences, it could be that increases in time spent in math were the most obvious improvements to be carried out and thus became the principal focus for teachers working alone.

Summary Statement

The primary purpose of this investigation was to determine if a teacher's level of implementation of the direct instruction model would vary as a function of the type of feedback received during initial attempts to apply the model. Twenty-five elementary school teachers were randomly assigned to one of three treatment conditions: 9 worked alone while analyzing tape recordings of two practice lessons; 9 received some feedback from the instructor during these analyses; and 7 worked through the practice tapes with their colleagues. The results of an ANCOVA test suggested that members of the three treatment groups did not differ in their overall level of implementation of the model during the lesson that served as the post test. In other words, different types of feedback did not result in different levels of implementation of the model. However, there is at least some reason to

believe that the three treatments did influence teachers to focus on different classroom events during their analyses of the practice lessons.

Although the three treatments did not produce differential levels of implementation, the study did substantiate the findings of Good and Grouws (1979). These authors have also reported that, with a modest level of instruction and support, fourth grade teachers are willing to adopt the direct instruction model for teaching elementary school mathematics.

It is important to note, however, that a small number of teachers were not enthusiastic about the model. Furthermore, most teachers were more willing to apply some of the specific components, such as seatwork and alerting, than they were to apply other aspects, such as asking students to work problems in their heads or assigning homework. Preliminary analyses suggest that resistance to all or some components of the model may be traced to firmly held teacher beliefs that run counter to practices suggested by the model (e.g., homework should not be assigned to youngsters in the early grades).

Despite these signs that many teachers did not endorse all components of the model, there is clear evidence that most teachers were enthusiastic about this method of teaching mathematics. This enthusiasm should provide encouragement to teacher educators and inservice directors who are responsible for initiating new curricula or methodology that is grounded in research on teaching.

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